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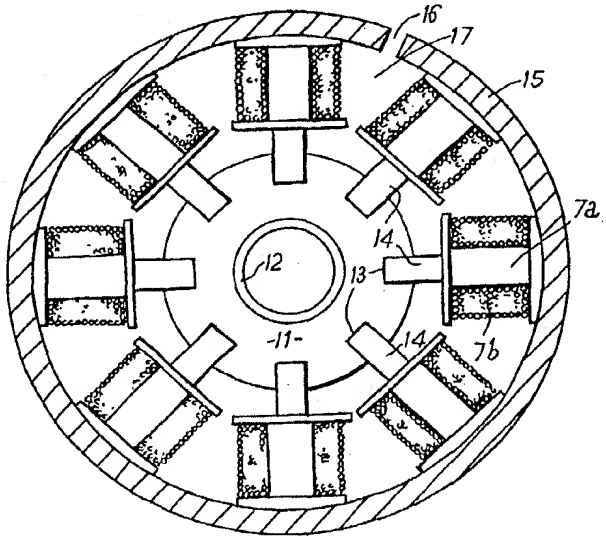
(54) **A wound core**

(57) A wound core for an electromagnetic device (e.g. a motor generator or transformer) comprises a core element of plastics material with particulate magnetic filling. Methods of fabrication include injection moulding of additional magnetic plastics material via channel 16 after placing the coils on premoulded core elements 7a. Premoulded elements need not be used (Figure 4, not shown). Magnetic alignment in the material may be effected immediately after injection. Materials are exemplified.

FIG. 3

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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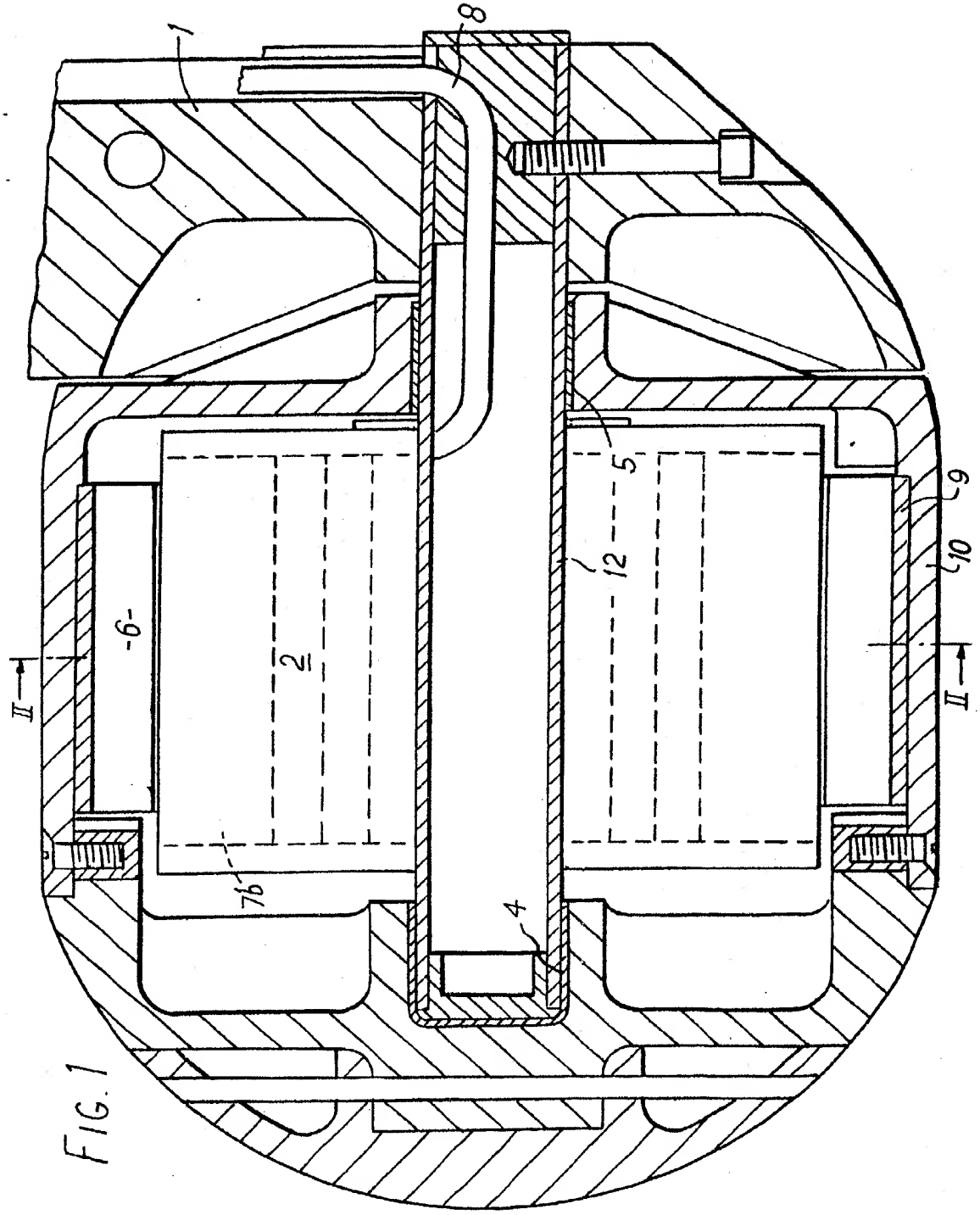


FIG. 1

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FIG. 2

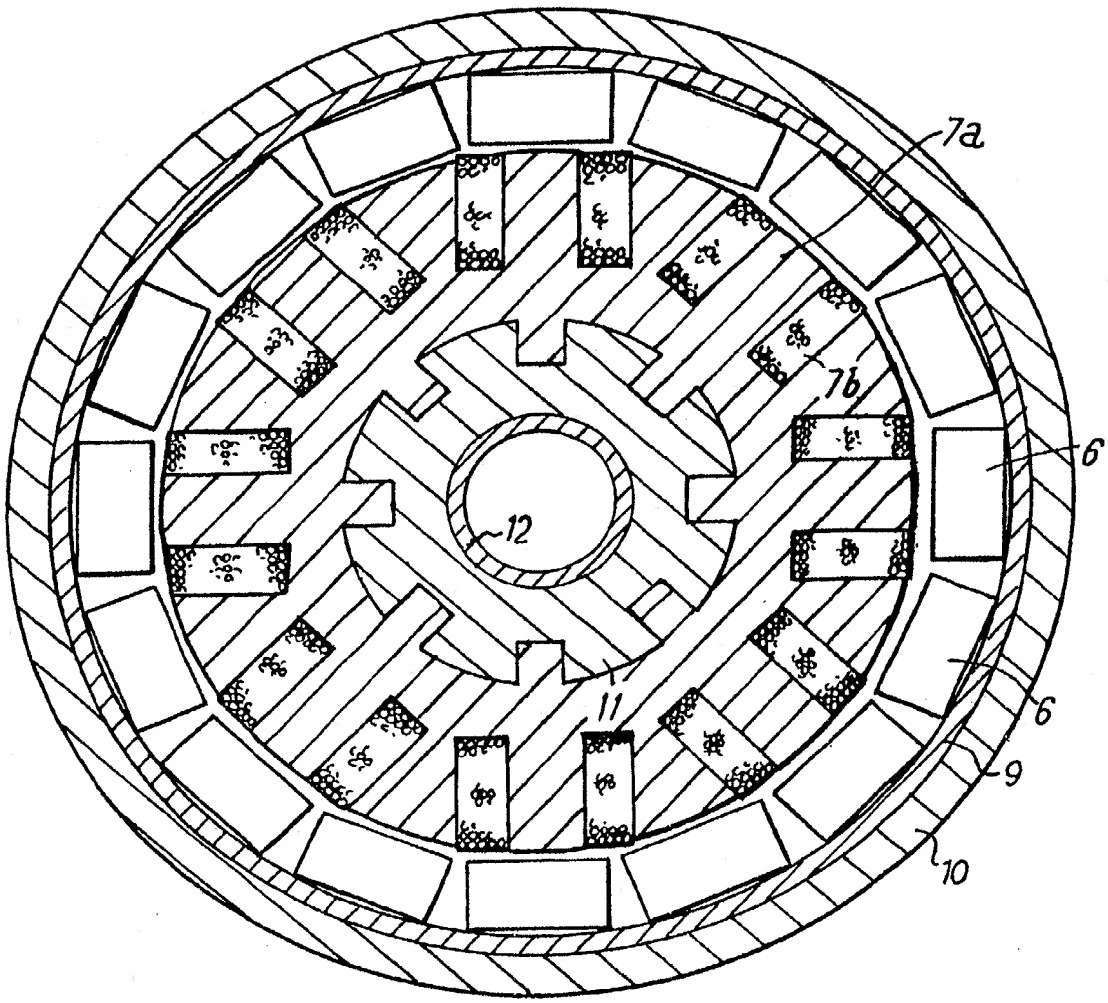

FIG. 3

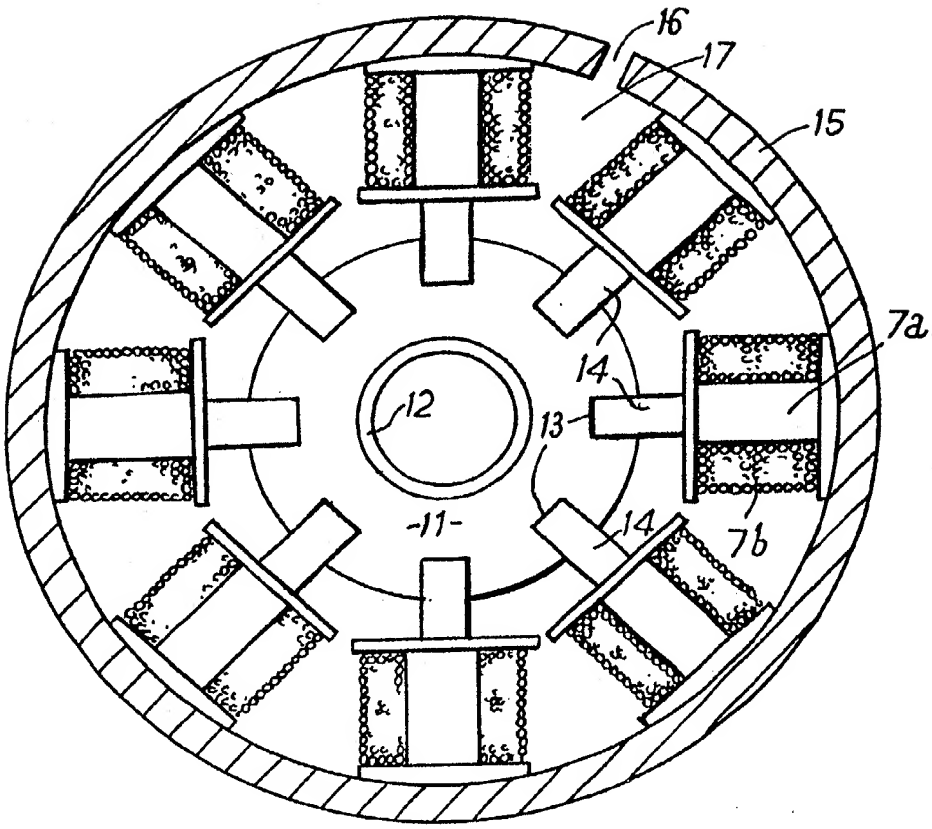

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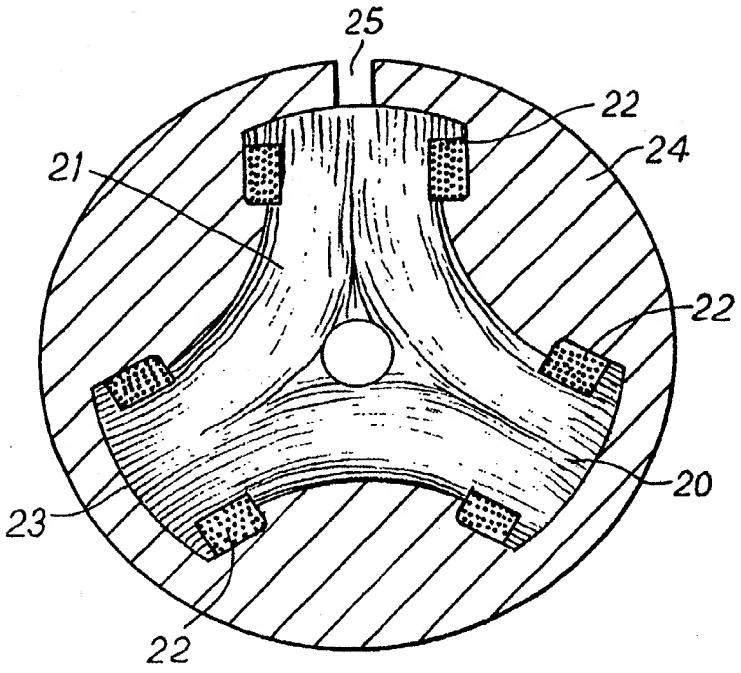
FIG. 4



SPECIFICATION

**A wound core**

The present invention relates to a wound core for an electro-magnetic device.

Such a wound core could be used as an electro-magnet, a transformer, or the stator and/or rotor of a motor or generator. Traditionally, such cores have been made of laminated soft iron.

According to one aspect of the invention there is provided a wound core for an electro-magnetic device comprising a core element of moulded magnetic plastics material, as herein defined, provided with a winding, the core element being shaped to accommodate the winding.

As used herein "magnetic plastics material" means a plastics material filled with particulate magnetic material.

The winding may be a single coil or a plurality of coils, which may be connected in series or in parallel or otherwise connected. Where a plurality of coils are required, each coil has its own core element.

The wound core of the device may be constituted by a single core element with one or more windings. Preferably, however, the core element has only one winding and where a plurality of windings are required on the core, the core is constituted by a number of magnetically coupled core elements, each with a respective winding.

According to another aspect of the invention there is provided a method of manufacturing a wound core consisting in the steps of winding a winding, positioning the winding in a mould and injecting magnetic plastics material (as herein defined), into the mould to form a moulded core element which accommodates the winding and holds it in position.

According to a further aspect of the invention there is provided a method of manufacturing a wound core having a plurality of coils the methof consisting in the steps of pre-moulding core elements from magnetic plastics material (as herein defined), placing the coils of the winding on respective core elements, assembling the core elements into position in the completed core and securing the core elements in position.

Whilst it is envisaged that the coils may be prewound on formers and shaped onto their core elements it is preferred that the coils are wound directly onto the core elements which act as formers. The core elements may be combined in sub assemblies each having a plurality of coils. However, it is preferred that the core elements be moulded singly and provided with only one coil each.

The core elements may be so shaped that on assembly they complete the magnetic circuits of the wound core. In this case, they may be secured in position merely by glue for example. It is however preferred that the core elements be such as to leave gaps therebetween requiring a further moulding operation with magnetic plastics material to fill the gaps and complete the magnetic circuits. For such further injection, the core elements may be assembled in a mould, or pre-assembled and placed in a mould, the further injection being made into the mould to complete the magnetic circuit in the core and secure the core elements in position.

Where, as in the preferred embodiments, the wound core is the central stator, or where it is a central rotor of an electro-magnetic machine, the core elements may be arranged around a central member of non-magnetic plastics material. They may be matched to the central member, e.g. by slots and may be glued thereto. After the said further injection to complete the magnetic circuits, a disc of non-magnetic material may be moulded onto the ends of the stator, or rotor, to encase the portions of the coils which would otherwise be exposed at the ends. The plastics material is preferably eposy resin material or polyester resin material. The particulate magnetic material is preferably soft iron filings or carbonyl or ferrite materials.

Immediately after any injection of magnetic plastics material, a magnetic field may be applied to the material as it sets to effect magnetic alignment in the material with the magnetic path which will exist in the wound core during use. This alignment, which may be a physical alignment of the particles of the magnetic material or alignment of magnetic domains, may be achieved by application of an external magnetic field or by pussing an electric current through the winding.

To help understanding of this invention, a specific embodiment and modification thereof will now be described with reference to the accompanying drawings in which:-

*Figure 1* shows a sectional side elevation of a generator including a wound core according to the invention,

*Figure 2* is a schematic cross-sectional view on the line II-II in Figure 1,

*Figure 3* is a diagram illustrating a step in the construction of the stator of the generator of Figures 1 and 2; and

*Figure 4* is a cross-sectional view illustrating manufacture of another wound core in accordance with the invention.

Referring to Figure 1 there is shown a generator which comprises a fixed support 1 to which is fixed a central stator 2. An external rotor 3 is mounted by bearings 4 and 5 to rotate relative to the stator. The rotor carries sixteen permanent magnets 6. The stator has eight magnetically salient poles, each comprising a wound core element such as that shown at 7 in Figures 2 and 3. Connections from the windings are led out at 8.

Figure 2 is a cross-section of the generator of Figure 1 and shows a mild-steel flux ring 9 on which the magnets 6 are mounted. The ring is encapsulated in an outer shell 10 of glass-fibre-reinforced epoxy resin. The core elements are mounted on a central non-magnetic cylindrical member 11 of silica-filled epoxy resin. In turn, this is set on a hollow stainless-steel shaft 12.

Figure 3 shows a step in the manufacture of the stator of the generator of Figures 1 and 2. Each wound core element 7 comprises a core element 7*a* and and a winding 7*b*. The core element 7*a* is pre-moulded of a magnetic plastics material which is epoxy resin filled with iron filings. The windings 7*b*

are subsequently wound on the core elements, using the elements as formers.

The central cylindrical member 11 is provided with slots 13 in which the core elements are inserted by way of projecting keys 14. The winding leads are fed through the central shaft and the assembly is mounted in a cylindrical mould 15. It will be seen that magnetically there are gaps between adjacent wound core element 7. Additional magnetic plastics material is injected into the mould via a channel 16 and is allowed to cure and thereby fill the gaps magnetically and bond the core elements in place. The additional material is shown in Figure 3 at 17.

During curing, a magnetic field is applied to the magnetic plastics material. This is effected by passing unindirectional current through the windings and the affect is to align the iron fillings, or at least their magnetic domains, with the flux to be experienced during operation of the generator.

Referring now to Figure 4 there is shown a stator 20 for an application similar to that of the stator of Figures 1 to 3. Here, however, there are no pre-moulded core elements. Instead, the core 21 is moulded within the three windings 22 and around a central hollow shaft 23. The windings and shaft as supported in a mould 24 into which magnetic plastics material is injected via a channel 25. Again, magnetic alignment may be effected by passing current through the windings during curing.

The invention is not restricted to the details of the embodiments described above with reference to the drawings. For example, the magnetic plastics material may comprise other plastics and other particulate magnetic fillers, such as ferrites or carbonyl materials, for example. Where the core elements are pre-moulded, they may nevertheless be subjected to magnetic alignment in the appropriate direction by application of a magnetic field during curing or setting.

The fluxing may be of magnetic plastics material instead of mild steel. The magnets may be of ceramic material (e.g. ferrite) for corrosion protection. The gaps between the magnets may be filled with the same material as the outer casing (e.g. glass-fibre-reinforced epoxy resin).

A suitable application for a generator of the kind described above is described in co-pending Patent Application No. 8008358. Here, the integral assembly of the stator in accordance with the present invention offers corrosion protection as well as ease of assembly.

CLAIMS

1. A wound core for an electro-magnetic device comprising a core element of moulded magnetic plastics material, as herein described, provided with a winding, the core element being shaped to accommodate the winding.

2. A method of manufacturing a wound core consisting in the steps of winding a winding, positioning the winding in a mould and injecting magnetic plastics material (as herein defined), into the mould to form a moulded core element which accomodates the winding and holds it in position.

3. A method of manufacturing a wound core having a plurality of coils the method consisting in the steps of pre-moulding core elements from magnetic plastics material (as herein defined), placing the coils of the winding on respective core elements, assembling the core elements into position in the completed core and securing the core elements in position.

4. A method as claimed in claim 3 wherein the wound core elements are assembled together in a mould with gaps therebetween, and magnetic plastics material is injected to fill the gaps, thereby completing the magnetic circuits of the core and bonding the elements in place.

5. A method as claimed in claim 3 wherein the elements are mounted on a central cylindrical member of non-magnetic plastics material.

6. A method or wound core as claimed in any of the preceding claims wherein the winding is wound on the core element which is pre-moulded and used as a former.

7. A method or wound core as claimed in any of claims 1 to 5 wherein the core element is moulded within the winding.

8. A method or wound core as claimed in any of the preceding claims wherein the moulded magnetic plastics material is magnetically aligned with the magnetic flux experienced therein during operation.

9. A method as claimed in claim 8 wherein the magnetic alignment is effected by application of a magnetic field during setting of the plastics material.

10. A method as claimed in claim 9 wherein the magnetic field is applied by passage of a current through the winding.

11. A wound core substantially as described with reference to Figures 1 to 3 or 4 of the accompanying drawings.

12. A method of manufacturing a wound core substantially as hereinbefore described with reference to Figures 1 to 3 or 4 of the accompanying drawings.

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